

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH ADMINISTRATION
BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

Project

Date October 30, 1950

Author Charles J. Johnson

TITLE

REPORT ON NUCULASPIS CALIFORNICA. (COLEMAN)

Forest Insect Laboratory
Coeur d'Alene, Idaho

SUBJECT—

INDEX NO.—

Report on Nuculaspis californica. (Coleman)

The black pine leaf scale Nuculaspis californica (Coleman) has come into the limelight during the recent years through reports of epidemic outbreaks. The city of Spokane, Washington and vicinity is the area in which the most recent outbreak has occurred. Other known outbreaks of black pine leaf scale have occurred at Orofino, Idaho and near San Bernadino, California.

Ponderosa pine is the principle tree attacked but it has been found on Lodgepole pine, Douglas fir and hemlock by other observers. Tree mortality from this insect is rare although some young Ponderosa pine were reported killed by this insect during the California outbreak.

The life cycle is one year and confined to the needles. The eggs hatch in July in the mid-temperate climate and the majority of the young crawlers migrate to the new needles, some remain on the year old needles and a few migrate to older needles.

Damage is characterized by shortness of needles and thinness of the crown. In some cases only two years of needles remain on the trees. Mottling of the needles occur where punctures by the stylet have been made. These mottled spots may coalesce to form yellowish patches which later may become reddish brown as necrosis becomes more severe.

I have found the scale insect Nuculaspis californica on Ponderosa pine needles in nearly every stand of Ponderosa pine visited. Their numbers under average forest conditions probably average less than one scale per tree. The scale insect is most readily found on trees growing near dusty roads or where grazing is prevalent.

In industrial areas where dusts and industrial gases tend to pollute the air with the subsequent settling of the dust or gas on the needles of Ponderosa pine; large populations of this scale insect quickly build up to epidemic proportions.

Although an abnormal condition, such as dusty foliage, must exist for an epidemic scale insect status, the actual role dust or other type of pollution is not too well defined. I have found areas of Ponderosa pine near industrial plants that are coated with dust yet no large scale populations were found. Therefore, I have reached the conclusion that the pollutant must produce some physiological change within the needle to make it more favorable for large insect populations. In a series of tests to determine the moisture content of needles it was found that needles with heavy scale infestation had an average moisture content of 52% while those with no scale insect had an average moisture content of 47%. The needle samples were taken from areas where there were large concentrations of dust but no scale, from areas of heavy

scale infestation, and from what would be considered a normal forest foliage. Only the current years' (1949) needles were used in each case and only the greenest needles were taken.

A 5% average moisture content does not seem to be a significant difference to cause a change from zero scale insects per needle to over 100 scale insects per needle and uninfested needles cannot be the whole story. The percent of available moisture for insect life may be a clue to the problem. If we assume that when the total needle moisture is 47% or less that the water is so bound in the plant tissues as to be unavailable to the scale insects and that any subsequent moisture in the needles is present as free water and hence available to the scale insects then the lack or presence of scale insects can readily be explained. Needle samples on which there were no scale insects the average needle moisture was 47% while on needles with living scale insects the average needle moisture was 52.9%. On a needle sample where complete scale insect mortality was recorded the average needle moisture was 44.4%. Graphic analysis shows the incidence of living scale insect to the percent of moisture very conclusively.

From this deduction there may be a correlation between needle moisture, amount of flourine, and number of scales. If we assume that industrial gases set up a physiological phenomena similar to the sensation of burning on the human body then we can make the following hypothesis. When the human body is burned body fluids are carried to the burned area to combat the effects of the burn. The presence of increased body fluids in a burned area is well evidenced by the formation of blisters. In a tree the process is similar. The industrial gases, such as flourine, cause a "burning" effect in the needles and so the tree rushes plant juices to the needles to combat the burning, this may be in the form of tissue destruction. With the increase in the water content of the needles more moisture is made available for insect livelihood, hence, increased scale insect population. With the advent of the scale insect the tree is required to send still more juices to the needles which in turn results in a still greater number of scale insects. This process continues until the tree wears itself out. With the wearing down of the tree - moisture in the needles is going to drop with a resulting decrease in the scale population and increase in burning caused by the gases. There may be a medium reached where the number of scale insects, amount of flourine burning, and available plant juices are in balance but then any upset in this balance by other insects or pathological diseases will surely result in the death of the tree.

Dust also results in the translocation of plant juices to the needles but the reason is somewhat different. In the tree the physiological process would be similar to the removal of foreign matter from the eye

by secretions of the lachromal glands. To bring about the process in the tree the dust must necessarily be small enough to enter the needle through the stomata and in sufficient quantity to cause congestion of the trachae and hence resulting in increased needle fluid there to remove this congestion. As a direct result of the increased needle fluid there is an increase in the scale insect population. If the dust concentration is very great it may form a clot in the trachae as a result the needle moisture is reduced below the minimum necessary for scale survival. The only possible reason why these needles with clogged trachae do not die is that osmotic processes may be sufficient for needle livelihoood. Further evidence of the apparent clogging the trachae in extremely dusty areas may be seen at Irvin or Metaline Falls, Washington on trees where there are no scale insects yet the newest needles are short and the internodes are much closed together. In dust areas the scale insect acts more as an expediting agent in causing needle shortening and reduced tree growth rather than being the entire degenerating agent.

Biological control through disease and insect parasitism does seem to be effective in the Spokane area. On recent samples where emergence holes serve as indicators of the cause of death less than 1/4 of the dead scale insects have died as a result of internal insect parasites. Evidence of feeding by predatious insects is lacking although lady bird beetles were seen on many trees. Feeding by birds can be classified as nil because of difficulty of a bird to balance itself on the needles. I have found the larval of another insect beneath the scale cap but, it is apparently not a predator on the scale insect for in every case the scale insect was alive. When these larva emerge they leave a large hole in the scale cap which may bring about death from other causes such as solar heat. Virus and bacterial disease account for a few deaths but I am of the opinion that the vast majority of the scale insect mortality is due to starvation.

The summer spray program of 1949 was ineffective in controlling the scale insect. The spraying was done during the crawler stage of the insect which is from mid-July to August. Light summer oils were used in high pressure spray equipment but control was negligible. Nicotine was used in conjunction with the summer oils and dosages up to 6% oil were tried with little to no effect on the crawlers. The 6% oil concentration did not cause any foliage damage despite the high temperatures recorded during the spraying period. A dormant spray program was tried during the spring of 1950 in which lime sulphur, dormant oils, and nicotine were used. Six percent dormant oil solutions were used as well as lime sulphur with concentrations as high as 1 to 7. There is no apparent increased foliage damage on any of the sprayed trees. A warm spell of weather followed by a cold spell is believed to be the cause of very high scale insect mortality throughout Spokane and vicinity. This high winter mortality in the spray plots nullified all the results we hoped to obtain from the dormant spray program. The cold air was apparently stratified for there was practically

complete scale insect mortality in the lower crown of some of the taller trees with only partial mortality in the upper crown. This means that the scale insect infestation has not been eliminated from the Spokane area and will probably rebuild to epidemic proportions very rapidly.

Coeur d'Alene, Idaho
July 3, 1950

Charles J. Johnson
Field and Laboratory Asst.
Washington Agricultural
Experiment Station